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Date of Deposit: 11-07-2005 By: Terrie Lindquist
Terrie Lindquist

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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| In re Applicant: | | § | |
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| | GLOVER, JOHN N. | § | |
| | | § | |
| Filed: | May 27, 1999 | § | Art Unit: 1723 |
| | | § | |
| Application No.: | 09/320,950 | § | Primary Examiner: David L. Sorkin |
| | | § | |
| For: FILTERING MEDIUM AND METHOD FOR CONTACTING SOLIDS CONTAINING FEEDS FOR CHEMICAL REACTORS | | § § § § | Docket No.: 20781.004 |

**PRE-APPEAL BRIEF REQUEST FOR REVIEW**

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Dear Sir:

In response to the Final Office Action dated June 7, 2005, for the above referenced application, Applicant hereby files this Pre-Appeal Brief Request For Review. A Notice of Appeal and a check for $250 for the required fee accompany this Request.

The Commissioner is hereby authorized to charge any additional fees that may be required or credit any overpayment to Bracewell & Giuliani LLP Deposit Account No. 50-0259 (Order No. 020781.004).

## REMARKS

The basis of this Request is the Primary Examiner's omission of one or more essential elements required for a prima facie rejection for obviousness under §103(a). Claims 59, 61 – 67, and 69 – 81 were rejected under the provisions of 35 U.S.C. § 103(a), as allegedly being obvious, over Kramer (US 4,615,796) (hereinafter "Kramer") in view of "CE Refresher: Catalyst Engineering, Part 2" by John Fulton (hereinafter "Fulton").

To establish a prima facie case of obviousness, three criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Second, there must be a reasonable expectation of success. Finally, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based upon Applicant's disclosure. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991).

The Primary Examiner has failed to factually support each of the elements of the prima facie case of obviousness in a number of ways, as described in further detail below.

<u>The References Do Not Teach or Suggest All Claim Limitations</u>

Claims 59, 61-67 and 69-81 relate to a method of fluid distribution. Applicant respectfully submits that the Primary Examiner has failed to point out the location in the Kramer or Fulton references where the element of fluid distribution is disclosed or suggested. Kramer instead discloses a method of <u>filtering</u>. Fluid distribution is not the same as, or equivalent to, filtering; nor is fluid distribution inherent in filtering. (See Amendment and Response dated February 17, 2005, copies of the relevant pages of which are attached hereto as Exhibit A, at pages 8-9).

Applicant also respectfully submits that the Primary Examiner has failed to point out the location in Kramer or Fulton where the feature of subdividing the organic-based feed stream into a plurality of smaller fluid streams by passing the organic-based feed stream through a plurality

of fluid flow passageways, or through at least some of the passageways, is disclosed or suggested. (See Exhibit A, page 9). This feature is expressly required by Claims 59, 67 and 78 and the claims dependent therefrom.

Also, Applicant submits that the Primary Examiner has failed to point out the location in Kramer or Fulton which teaches the use of elliptical openings. (See Exhibit A, pages 11-12). This feature is claimed in Applicant's Claims 59, 67 and 78 and the claims dependent thereon. The Primary Examiner contends that Fulton teaches circular openings, and that the broadest reasonable definition of an ellipse includes a circle. However, Applicant's elliptical shaped openings provide improved fluid distribution properties when compared to circular openings (see No Reasonable Expectation of Success below), which indicates that ellipses and circles are indeed distinguishable from each other, both in shape and result achieved.

No Reasonable Expectation of Success

The Primary Examiner has not shown where the combination of Kramer and Fulton indicates or suggests that Applicant's claimed invention would have a reasonable expectation of success. In contrast, Applicant's use of the ceramic units with elliptical openings unexpectedly results in advantageous fluid distribution properties, such as improved horizontal fluid distribution and significantly decreased pressure drop across a filter bed. (See Exhibit A, pages 10-11). To support these assertions, Applicant submitted the declaration of the inventor John N. Glover. (See Declaration accompanying Amendment and Response dated February 17, 2005, attached as Ex. B).

In addition to the unexpected results obtained by the ceramic units of the present invention, the Assignee of Applicant has enjoyed substantial commercial success from the sale of the ceramic units of the present invention. (See Exhibit A, page 12). The commercial success of the ceramic units made in accordance with the present invention should be considered indicative of the fact that the ceramic units have met a long felt, unfilled need in the ceramic filter industry. *See id.*

No Suggestion or Motivation to Combine References

The Primary Examiner has not shown or specifically identified the motivation in Kramer and Fulton for modifying the spherical particles found therein to produce Applicant's claimed invention. The Examiner explains that in Kramer, alternative shaped units can be used. However, the Examiner does not specifically identify the motivation for one skilled in the art to drastically modify the spherical particles of Kramer, which are used for filtration purposes, to form cylindrical particles used for flow distribution purposes, particularly when spheres are described in Kramer as being the "very preferred" shape. (See Exhibit A, page 10). Further, the Examiner does not specifically identify the motivation for one skilled in the art to take the additional steps of forming (i) a central opening in the cylindrical particle and (ii) a plurality of other openings surrounding the central opening. Even further, the Examiner does not specifically identify the motivation for one skilled in the art to take the next additional step of making the plurality of surrounding openings elliptical in shape, particularly when elliptical openings are not shown or suggested in Fulton. *See id.*

As a whole, the Kramer and Fulton teachings and the nature of the problem to be solved would not prompt or motivate one of ordinary skill in the art to combine the alleged teachings of references and create Applicant's claimed invention. The Examiner has not set forth the prima facie elements necessary to show why one with ordinary skill in the art would be willing to combine the Kramer and Fulton references to provide the missing elements of the current invention. The Examiner has merely attempted to piece together Applicant's invention from the cited references using hindsight reconstruction, which is impermissible.

For these reasons, Applicant respectfully submits that the rejection of the Claims under 35 U.S.C. § 103(a) is improper.

## CONCLUSION

In view of the foregoing remarks, reconsideration of the claims is respectfully requested. Applicant submits that the presently presented claims are allowable, and therefore requests the issuance of a Notice of Allowance.

7 B.P.T.

Date: November ~~4~~, 2005

Respectfully submitted,

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ATTORNEYS FOR ASSIGNEE,
CRYSTAPHASE INTERNATIONAL, INC.

OIPE IAP78 NOV 1 0 2005 PATENT & TRADEMARK OFFICE

CERTIFICATE OF MAILING – 37 C.F.R. § 1.8

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date of Deposit: 02-17-2005 By: Terrie Lindquist

Terrie Lindquist

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| In re Applicant: | | § | |
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| Application No.: | 09/320,950 | § | Examiner: David L. Sorkin |
| | | § | |
| For: FILTERING MEDIUM AND METHOD FOR CONTACTING SOLIDS CONTAINING FEEDS FOR CHEMICAL REACTORS | | § § § § | Docket No.: 20781.004 |

## AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Dear Sir:

In response to the Office Action dated August 17, 2004, Applicant files the following Amendment and Response. Reconsideration of this application is respectfully requested. A Request for Extension of Time and accompanying check for $510.00 is also enclosed herewith.

The Commissioner is hereby authorized to charge any additional fees that may be required or credit any overpayment to Bracewell & Patterson, L.L.P. Deposit Account No. 50-0259 (Order No. 020781.004).

claims 65, 70 and 76 describe ceramic filter units with outer peripheries having a plurality of recessed notches. (FIG. 16).

A common feature of these polygonal shaped units and units with fluted surfaces or recessed notches of the present invention is that they each have sharp corners or edges on the outer peripheries of the unit surface. Newly added claims 82-85 specifically recite this feature of sharp edges. This feature is shown in the present application in the filter units of FIGS. 5-11, 13 and 16.

Fulton teaches, however, that sharp corners are a disadvantageous feature and should be "eliminated" as a potential shape option. (see page 97, ¶ 3). Fulton teaches that sharp corners would crumble in service, and the resulting dust and fragments would plug the bed spaces between pellets and cause premature buildup in bed pressure drop. (see page 97, ¶ 3).

Thus, Fulton teaches away from the use of sharp corners or edges on the outer peripheries of supported catalyst. Applicant respectfully submits that it would not be obvious to one skilled in the art to utilize the sharply cornered shapes shown in Figure 1 of Fulton in the design of the ceramic filter units shown in Kramer, as there is no suggestion or motivation to combine the references. As such, Applicant respectfully submits that its present claims 64, 65 and 67 and their dependent claims, as well as newly added claims 82 - 85, relating to this particular feature are nonobvious and patentably distinct.

In addition to the arguments presented above, Applicant maintains and resubmits the following arguments, which were previously presented in similar, but not identical, form in Applicant's office action response dated November 5, 2003.

<u>Fluid Distribution is Not Filtering</u>

Applicant respectfully submits that Kramer does not disclose a method of *fluid distribution*, but rather a method of *filtering*. As described in col. 3, lines 8 – 15, Kramer teaches the removal of suspended solids, preferably iron sulfide, of greater than 10 microns in diameter from mixed phase gas-liquid-solid streams. Kramer is tailored to correcting a specific problem in the petroleum processing industry, namely removal of materials similar to iron sulfide. No

mention is made in the Kramer disclosure of fluid distribution. Fluid distribution is not the same or equivalent to filtering.

Applicant also respectfully submits that Kramer also does not disclose the step of "subdividing the organic-based feed stream into a plurality of smaller fluid streams by passing the organic-based feed stream through the plurality of fluid flow passageways". An embodiment of Applicant's invention involves the use of ceramic filter units with openings, wherein the particular fluid in the reactor may not only pass around a unit in the layer, but also through at least some of the ceramic filter units by using the plurality of fluid flow passageways created by the openings in at least some of the ceramic filter units.

Shapes of the Units

Although Kramer does explain that alternative shaped units can be used (col. 4, lines 1 – 4), with spheres being the preferred shape, there is no suggestion that a ceramic filter unit with openings, specifically three or more passages surrounding a central passage, can be used. Applicant's claims 59, 67, and 78 require that the surrounding openings have an elliptical shape. Kramer repeatedly indicated that a sphere was the unit of choice. Every example given in Kramer illustrated the use of a sphere without any openings. More specifically, Examples 1, 2, and 3 in Kramer exclusively uses spheres as the filtering medium.

An important aspect of an embodiment of the present invention is to uniformly distribute the organic-based feed stream across a catalyst bed to prevent channeling and other deleterious consequences by passing the stream through openings in the units. The spherical units disclosed within Kramer would not provide the required flow through at least some of the units.

Declaration of Inventor

Applicant's use of the ceramic units of the present invention unexpectedly results in advantageous fluid distribution properties, such as improved horizontal fluid distribution and significantly decreased pressure drop across a filter bed. To support these assertions, Applicant has submitted the attached declaration of John N. Glover (hereinafter referred to as the "Declaration"). Mr. Glover has substantial experience in the ceramic and catalyst industries and has participated in experiments resulting in unexpected and surprising, advantageous fluid distribution properties. The Declaration also provides evidence of the commercial success of these ceramic units, which is indicative of the fact that the claimed ceramic filter units of the present invention should be deemed to have met a long felt, unfilled need in the petroleum refining and petrochemical industries. Applicant has performed experiments comparing the ceramic filter units of the present invention with prior art ceramic units that are structurally similar to ceramic units, such as those found in Fulton and Kramer.

It should be noted that according to the Applicant, to the best of his knowledge, the Fulton Ceramic Unit was not commercially available at the time of the experiments and thus

could not be tested. (see page 2, ¶ 7). A similar commercially available unit ("Product C") was instead utilized. *Id.*

Several measurements were taken during the experiments to help determine the amount of lateral fluid distribution that was achieved using several different ceramic units. Table I summarizes the results of each experiment. The best results are indicated by boxed numbers. Five prior art ceramic units (Products A, B, C, D, and E) were compared to three ceramic units made in accordance with the present invention (Products F, G, and H). The prior art ceramic unit results are shaded in gray in Table I and the results for the ceramic units made in accordance with the present invention are non-shaded and located on the right side of Table I. Descriptions of the Products tested can be found in Paragraphs 5 – 10 of the Declaration and in Table I in row labeled as "Product". Samples of the two best performing prior art ceramic units, Products C and E, were included in Applicant's response dated November 5, 2003. Samples of the two best performing ceramic units made in accordance with the present invention, Products F and H, were also included in Applicant's above indicated response.

A detailed description of the experiments that were performed and the apparatus is included in the Declaration in paragraphs 11 – 23. The ceramic units of the present invention performed significantly better than the prior art units similar to those shown in Fulton and Kramer. The experiments showed that there was a substantial increase in the lateral distribution using the ceramic units of the present invention as opposed to the ceramic units with the shapes similar to those shown in Fulton and Kramer.

As described in paragraphs 24 – 25 of the Declaration appended hereto, the ceramic units made in accordance with the present invention performed significantly better than the prior art ceramic units consistently through each experiment that was performed. The experiments illustrate the unexpected results obtained by using the present invention as opposed to the prior art ceramic units. The ceramic units made in the accordance with the present invention provided more lateral distribution for fluid than the prior art ceramic units did.

Claims 59, 66 – 67, and 77 – 78 recite the use of elliptical openings. Support in the specification for the amendments can be found in FIGS. 4, 5, and 12 of the specification. Neither

of the references taken alone or in combination with each other describe a ceramic unit with a central opening and three or more elliptical openings.

Use of elliptical openings also provides an additional design parameter to specify when designing the ceramic units to maximize the amount of material that is allowed to pass through the body of the ceramic unit. For instance, when a circular shape is used for the surrounding openings, as in the Fulton Ceramic Unit, the design parameters that can be changed include the unit diameter, the unit length, the central opening diameter, the number of outer openings, the location of the center of the outer openings, and the diameters of the outer openings. If elliptical outer openings are used, the design parameters that can be changed include the unit diameter, the unit length, the central opening diameter, the number of outer openings, the location of the center of the outer openings, the major axis of the elliptical openings, and the minor axis of the elliptical openings. Using elliptical openings, along with the central opening, provides better control of the amount of fluid distribution and filtering provided by the ceramic units. This allows manufacturers to better customize the ceramics for each application. If more lateral distribution is required in a particular application, then the manufacturers have an additional parameter to optimize to improve lateral distribution.

In addition to the unexpected results obtained by the ceramic units of the present invention, the Assignee of Applicant has enjoyed substantial commercial success from the sale of the ceramic units of the present invention, as described in Paragraph 26 of the appended Declaration. In the period from 1998 to the execution of the Declaration in 2003, Applicant's Assignee sold more than eight million dollars worth of ceramic units, which correlates to approximately 40,000 cubic feet of unit sold. At the time, the ceramic units of the present invention were the number two selling ceramic units with approximately 30% - 35% of the market. The commercial success of the ceramic units made in accordance with the present invention should be considered indicative of the fact that the ceramic units have met a long felt, unfilled need in the ceramic filter industry.

As indicated previously, neither Kramer nor the combination of Kramer and Fulton disclose the present invention. The Federal Circuit noted in *In re Fritch* that:

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| In re Applicant: GLOVER, JOHN N. | § | |
| Filed: May 27, 1999 | § | Art Unit: 1723 |
| Application No.: 09/320,950 | § | Examiner: David L. Sorkin |
| For: FILTERING MEDIUM AND METHOD FOR CONTACTING SOLIDS CONTAINING FEEDS FOR CHEMICAL REACTORS | § | Docket No.: 20781.004 |

## DECLARATION OF JOHN N. GLOVER

I, John N. Glover, declare that I am over the age of twenty-one (21) years of age and am fully competent to make this declaration. I have personal knowledge of the facts set forth in this declaration and they are true and correct. I declare:

1. I am the President of Crystaphase International, Inc. and its related corporate entities (hereinafter "Crystaphase"), and maintain an office at Crystaphase at 16825 Northchase Drive, Suite 660, Houston, TX. 77060-6029. I have been employed by Crystaphase since 1989 to the present as the President. I am the name inventor in the above-identified patent application and am familiar with the disclosure in the above-identified patent application.

2. I have worked in the petroleum refining and petrochemical industries for at least twenty-four years. I am familiar with ceramic filter units, catalysts, and recycling of these units.

3. I am a named inventor of the subject application and thus would be considered of above-ordinary skill in the art of ceramic filter units and associated methods. In my position of President, I have supervised numerous individuals and therefore am knowledgeable about the level of understanding of one with ordinary skill in the art in the field of ceramic filter units.

4. My educational experience includes undergraduate studies in Biology and Chemistry. I have performed numerous experiments on the subject matter of the above referenced patent application. I am extremely familiar with terms in the industry and the understanding associated with those terms throughout the industry.

5. I participated in an experiment in which comparative performance data was obtained for ceramic filter units comparing ceramic units in accordance with the present invention having combinations of elliptical and circular openings, along with flutes, to ceramic units in accordance with prior art units having combinations of circular openings and flutes. Five prior art ceramic units (Products A, B, C, D, and E) were compared to three ceramic units made in accordance with the present invention (Products F, G, and H, as shown in FIG. 4 of the present application).

6. Products A and B were spherical ceramic balls made in accordance with the ceramic units in U.S. Patent No. 4,615,796 issued to Kramer (hereinafter "Kramer"), with Product A having a 6" bed and Product B having a 12" bed.

7. Product C was a 5/8" disc with six circular openings and one central circular opening that is substantially similar to the closest prior art in "CE Refresher: Catalyst Engineering, Part 2" by John Fulton (hereinafter "Fulton") as shown at Fig. 1, third column, fifth row (hereinafter "Fulton Ceramic Unit"). A sample of Product C has been included and is labeled as C. Product C is manufactured by Haldor Topsoe A/S and is commercially available as TK-10. TK-10 has been on the market for approximately seventeen years and is the number one selling ceramic unit. Product C (i.e., TK-10) is the closest commercially available ceramic unit structurally to the Fulton Ceramic Unit. Product D is a 7/8" disc with six circular openings and one central circular opening. Product D is substantially similar to Product C, but with a larger diameter. To the best of my knowledge, the Fulton Ceramic Unit is not commercially available.

8. Product E is a 5/8" ceramic unit with one central circular opening and six flutes. Product E is commercially available as Dypor 607 and is manufactured by Dytech Corporation, Ltd. in Sheffield, England. A sample of Product E has been included and is labeled as E.

9. Product F is a 5/8" ceramic unit with one central circular opening and four surrounding elliptical openings made in accordance with the present invention. A sample of Product F has been included and is labeled as F. Product G is a 7/8" disc with one central circular opening and four surrounding elliptical openings, also made in accordance with the present

invention. Products F and G are commercially available as BG-1000 and are sold by the Assignee of the present invention.

10. Product H is a 7/8" elongated disc with one central circular opening and four surrounding elliptical openings made in accordance with the present invention. Product H is commercially available as BG-1002 and is sold by the Assignee of the present invention. A sample of Product H has been included and is labeled as H. Product H is twice as long as Product G.

11. A test apparatus was constructed using a 12" internal diameter by 18" tall 26 gauge steel cylinder with a collection grid inside the cylinder, as shown in FIG. 1 attached hereto. The collection grid was constructed of ½" thick grating on top of a solid plate, which was placed in the bottom of the cylinder as a collector floor, as shown in FIG. 3 attached hereto. The plate was drilled with 253 holes through the cells of the grating, each having a ¼" diameter. Each one of the holes was centered in the collection grid with 0.65" centers, which created collection squares or cells, as shown in FIG. 3 attached hereto. The collection grid was secured to the floor using a silicon sealer.

12. Clear plastic tubes were pressed into each hole from below until the tubes extended approximately 1/16" above the top of the plate. A watertight seal was formed around each of the tubes. A clear plastic baffle was drilled to match the holes in the collector floor and installed ½" above the end of the 8" plastic tubes, as shown in FIG. 2 attached hereto. Both the collector and the lower portion of the plastic tubes were marked to accurately identify each individual tube during experimenting.

13. A single flow-regulated water inlet was installed so that the inlet could be accurately centered and placed six inches above the top of the bed to be tested. A six inch headspace is commonly used in trickle bed reactors into which the present invention is commonly installed. The water flow rate used in the experiments was one liter per minute.

14. The flow device and the steel cylinder/collector assembly were mounted on a seven foot tall stand. The fluid flow collection was at eye-level, where it could be easily observed.

15. A 1,000 mL graduated cylinder was used to collect and measure the flow through a single tube. A tight fitting funnel was placed over the cylinder to ensure that no water would enter other than through the single plastic tube. The funnel was slip-fitted over each collector tube one at a time. A digital timer was used for timing.

16. Several measurements were taken during the experiments to help determine the amount of lateral fluid distribution that was achieved using several different ceramic units. Table I summarizes the results of each experiment. The prior art ceramic unit results are shaded in gray in Table I and the results for the ceramic units made in accordance with the present invention are non-shaded and located on the right side of Table I.

17. The first measurement that was used to compare the lateral fluid distribution caused by the ceramic units was a determination of the number of cells that had liquid flow present within the collection grid. The larger the number of cells with flow, or active cells, indicates better lateral distribution because the feed stream is distributed across a larger area containing cells. The lower the flow rate within each cell also indicates better lateral distribution due to the dividing of the feed stream by the cells that distributes the feed stream better laterally. The results of this experiment are shown in Table I in the row labeled as "1. Total Number of Active Cells" and "2. % of Active Cells." The percentage of active cells is calculated by dividing the number of active cells by the total number of cells, 253. The best performing prior art ceramic unit was Product E. The best performing ceramic unit made in accordance with the present invention was Product F. Product F had 11% more active cells than the best performing prior art ceramic unit in this experiment, which represents a 46% improvement over the prior art.

18. The next experiment that was conducted determined an active area of the grid in which flow was determined and is labeled as the row "3. Area of Active Cells". The larger the Area of Active Cells, the better. The larger Area of Active Cells indicates better lateral distribution than a smaller Area of Active Cells. The Area of Active Cells was calculated by multiplying the horizontal distance of the active cells by the vertical distance of the active cells. Not every cell within the Area of Active Cells has flow. The ceramic unit made in accordance with the present invention labeled in Table I as Product F performed the best with the greatest Area of Active Cells being 180. The prior art ceramic unit labeled as Product C in

Table I performed the best with 143 active cells. It is believed that Product C would perform better than the Fulton Ceramic Unit because Product C has more openings than the Fulton Ceramic Unit. Product F made in accordance with the present invention performed approximately 26% better than the prior art Product C in this experiment.

19. Measurements were taken to determine the distance the flow was laterally distributed based upon the feed location. Product H, which is made in accordance with the present invention, performed the best compared to any of the tested ceramic units, with a total of ten cells with flow located greater than five cells away from the central feed location and three cells with flow located greater than six cells away from the central feed location. Out of the prior art ceramic units that were tested, the best performance was obtained by using Product C. Product C only had two cells with flow located greater than five cells away from the central feed location. No cells greater than six cells away from the central feed location had any flow in them in the prior art ceramic units. Product H performed at least five times better than Product C when determining the number of active cells greater than five cells away from the feed stream location. Product H performed at least three times better than Product C when determining the number of active cells greater than six cells away from the feed stream location.

20. Measurements were also taken of the flow rates within each cell. A lower flow rate is indicative of better lateral distribution, since the flow is distributed across a larger number of cells. The present invention embodiments with one central opening and surrounding elliptical openings consistently outperformed the prior art units tested.

21. The average flow rate per active cell was determined for each active cell. To determine this average flow rate, the total inlet feed flow rate was divided by the number of active cells. The lower the average flow rate, the better. A lower average flow rate per active cell indicates that the feed stream was distributed among a greater number of active cells. Product F performed the best with only 1.16% average of the flow rate. With respect to the prior art ceramic units, Product E performed the best with 1.69% average of the flow rate. The prior art with the closest structural similarity to the Fulton Ceramic Unit, Product C, had a 1.72% average of the flow rate. The present invention performed approximately 30% better than the best performing prior art ceramic units tested.

22. The maximum flow rate in a cell was also measured for all of the tested ceramic units. The maximum flow in a cell was determined by measuring the flow rates of each active cell and determining the highest flow rate of those cells. In this experiment, the lower the maximum flow rate, the better. The best performing ceramic unit tested was Product F with only a 4.46% maximum flow rate in any one cell. The best performing prior art ceramic unit was Product C with an 8.45% maximum flow rate in any one cell. The best embodiment of the present invention, Product F, performed approximately 47% better than the best performing prior art ceramic unit tested, Product C.

23. Measurements for the percentage of active cells with greater than 3% of total flow and greater than 5% of total flow were also taken. The percentage of active cells with greater than three and five percent of the total flow was determined by comparing the flow rates of the active cells with three and five percent of the total flow rate of the inlet feed stream respectively. With respect to the experiment measuring greater than 3% of total flow, the best performer in accordance with the present invention was Product H with only 8.33% of the cells having a flow rate greater than 3% of the total flow rate. The best performing prior art was Product C with 17.24% of the cells having a flow rate greater than 3% of the total flow rate. In this experiment, the lower the percentage of active cells with greater than 3% of total flow, the better. The present invention, Product H, performed approximately 52% better than the prior art ceramic units, Product C, in this experiment. With respect to the experiment measuring greater than 5% of total flow, the best performer in accordance with the present invention was Product H with 0% of the cells having a flow rate greater than 5% of the total flow rate. The best performing prior art was the Product E with 5.08% of the cells having a flow rate greater than 5% of the total flow rate. In this experiment, the lower the percentage of active cells with greater than 5% of total flow, the better. The present invention, Product C, performed significantly better than the prior art ceramic units, Product E, in this experiment also.

24. To the best of my knowledge and understanding, based upon experiments that I performed, lateral fluid distribution was improved in all performance indicators measured when using the ceramic units of the present invention compared with use of prior art ceramic units.

Product F performed the best consistently when compared with the consistently best performing prior art ceramic filter unit, Product C.

25. The attached Table I demonstrates the amount of lateral fluid distribution that was obtained by using the ceramics of the present invention and prior art ceramic units. As can be seen from the Table I, advantageous properties are associated with the use of the central opening with elliptical openings. The advantageous properties resulting from the use of elliptical openings are unexpected.

26. Crystaphase has enjoyed much commercial success from the sale of these ceramic units. Crystaphase began selling the ceramic units made in accordance with the present invention in 1998. Since then, Crystaphase has sold more than eight million dollars worth of units made in accordance with the present invention, which approximates 40,000 cubic feet of product being sold, which correlates to about 30% – 35% of the total market over the past six years. With so many units sold, the ceramic units should be deemed to have met an unfilled need in the industries in which these ceramic units have been sold.

27. I believe there is no motivation for one of ordinary skill in the field of ceramic filter units to utilize ceramic disc units containing a central circular opening and at least three elliptical openings in accordance with the present invention, at least without resorting to hindsight after viewing the present invention.

28. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Sec. 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the publication or any patent issued thereon.

11/5/03
Date

John N. Glover

# TABLE I - SUMMARY OF COLD FLOW EXPERIMENT RESULTS

| Shape | PRIOR ART | | | | | PRESENT INVENTION | | |
|---|---|---|---|---|---|---|---|---|
| | Spheres | | Cylindrical Openings | | | Elliptical Openings | | |
| Product | A (3/4" Ceramic balls) | B (3/4" Ceramic balls) | C (5/8" TK-10) | D (7/8" TK-10) | E (5/8" Dypor 607) | F (5/8" BG-1000) | G (7/8" BG-1000) | H (7/8" BG-1002) |
| Top layer – Depth | 6" | 12" | 6" | 6" | 6" | 6" | 6" | 6" |
| Shape | Sphere | Sphere | Disc with 7 cylindrical openings | Disc with 7 cylindrical openings | Disc with one cylindrical opening and six flutes | Disc with four elliptical and one central circular openings | Disc with four elliptical and one central cylindrical openings | Elongated Disc with four elliptical and one central cylindrical openings |
| Void space | n/a | n/a | 55% | 55% | 60% | 60% | 60% | 63% |
| | | | | | | | | |
| Bottom layer – Depth | 6" | - | 6" | 6" | 6" | 6" | 6" | 6" |
| Size and Shape | ¾" Sphere | - | ¾" Sphere | ¾" Sphere | ¾" Sphere | ¾" Sphere | ¾" Sphere | ¾" Sphere |
| Void space | ~39 % | - | ~39 % | ~39 % | ~39 % | ~39 % | ~39 % | ~39 % |
| 1. Total number of active cells | 36 | 46 | 58 | 46 | 59 | 86 | 69 | 84 |
| 2. % of active cells | 14.23% | 18.18% | 22.92% | 18.18% | 23.32% | 33.99% | 27.27% | 33.20% |
| 3. Area of Active Cells | 49 | 100 | 143 | 72 | 120 | 180 | 121 | 153 |
| 4. Number of active cells greater than 5 cells distance from center | 0 | 0 | 2 | 0 | 1 | 4 | 2 | 10 |
| 5. Number of active cells greater than 6 cells distance from center | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 6. Average Flow Rate per Active Cell | 2.78% | 2.17% | 1.72% | 2.17% | 1.69% | 1.16% | 1.45% | 1.19% |
| 7. Maximum Flow Rate in a Cell | 10.42% | 7.03% | 8.45% | 10.39% | 9.07% | 4.46% | 7.17% | 9.74% |
| 8. Percentage of active cells greater than 3% of total flow | 27.78% | 23.91% | 17.24% | 26.09% | 23.73% | 10.47% | 8.70% | 8.33% |
| 9. Percentage of active cells greater than 5% of total flow | 25.00% | 8.70% | 5.17% | 6.52% | 5.08% | 0.00% | 7.25% | 3.57% |